DOCUMENT RESUME

ED 150 177 TM 006 892

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TITLE The Definition and Measurement of Verbal Comprehension.
INSTITUTION Civil Service Commission, Washington, D.C. Personnel Measurement Research and Development Center.
REPORT NO PRDC-TM-77-11
PUB DATE Aug 77
NOTE 15p.
AVAILABLE FROM Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (Stock Number 730-645/1641)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS Cognitive Ability; Cognitive Measurement; *Comprehension; Factor Analysis; Literature Reviews; *Reading Comprehension; *Test Items; *Verbal Ability; *Verbal Tests; *Vocabulary Skills
IDENTIFIERS Air Force; Thurstone Primary Mental Abilities Schema; *Verbal Comprehension

ABSTRACT

The factor-analytic history of the isolation and identification of the mental ability construct known as verbal comprehension is traced through the psychometric literature. Examples of the most important item types which have been found to measure this factor--defined as the ability to understand the English language--are discussed. It has been documented that verbal comprehension can be consistently identified by a variety of verbal measures, especially those concerned with vocabulary or reading. Vocabulary items were found to be the purest measures of the factor, while reading comprehension items sampled broader aspects of the ability. (Author/BW)

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The Definition and Measurement of Verbal Comprehension

TM006 892

United States
Civil Service Commission
Bureau of Policies and Standards

Technical Memorandum 77-11

THE DEFINITION AND MEASUREMENT OF VERBAL COMPREHENSION

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Washington, D. C. 20415
August 1977

THE DEFINITION AND MEASUREMENT OF VERBAL COMPREHENSION

ABSTRACT

The factor-analytic history of the isolation and identification of the mental ability construct known as Verbal Comprehension is traced through the psychometric literature in this report. Examples of the most important item types which have been found to mark this factor are presented and discussed. The association of some of these item types with other ability factors is also pointed out.

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VERBAL COMPREHENSION

Verbal Comprehension is a well-established ability construct (or factor) which is defined as "the ability to understand the English language" and which can be found in at least 125 published studies (Ekstrom, French and Harman, 1976, p. 163). It is also identified in Cattell's Universal Index (Cattell, 1953) as T13 and in Guilford's Structure of Intellect Model (Guilford and Hoepfner, 1971) as Cognition of Semantic Units, Relations and Systems. This factor involves the comprehension of the English language (French, 1951). The factor is a very stable one; despite the variety of tests which load on it, it repeatedly appears in factor-analytic studies when tests in the verbal medium are included in the test battery and it shows great resistance to breaking up into sub-factors. Garrett (1938) and Woodrow (1939) each reported rather inconclusive, exploratory factor studies on differential mental traits. Each isolated a primarily Verbal and a primarily Numerical component from the test batteries employed (Garrett used 9 tests, Woodrow, 52). Factor loadings on the Verbal factor ranged from .47 to .88 for verbal items involving opposites, similarities, analogies and proverbs.

Thurstone's Primary Mental Abilities

The first major factor-analytic study which identified a Verbal factor was carried out by Thurstone (1938), who classified Verbal Comprehension as one of the clearest mental abilities. A variety of tests loaded highly on this factor. These included tests of similarities, opposites, verbal analogies, proverbs, quotations, vocabulary, grammar and spelling. The following is a partial list of the Thurstone tests which achieved loadings greater than .30 on the Verbal factor, with examples of items from each.

Inventive Opposites	.635
Verbal Analogies	.597
Reading I (Proverbs)	.552
Reading II (Quotations)	.506
Grammar	.498
Inventive Synonyms	.495

Examples:

Inventive Opposites - a test of ability to think of words. The examinee was asked to supply two words, opposite in meaning to a given word, and which began with specified letters.

narrow b broad w wide

pg. 27

Verbal Analogies

foot: shoe :: thumb:
a) head b) glove c) finger d) clasp

pg. 48

Reading I (Proverbs) - a test of ability to understand what is read. The examinee was asked to choose two alternatives with nearly the same meaning as the given proverb.

Tall oaks from little acorns grow.
A) No grass grows on a beaten road
*B) Large streams from little fountains flow.
C) The exception proves the rule.
*D) Great ends from little beginnings.

pg. 23

Reading II (Quotations) - same instructions as for Reading I.

"In calamity any rumor is considered worth listening to."-
Publius Syrus

*A) A drowning man grasps at a straw.
B) Rumors are seldom truthful.
C) Thy neighbor is thy teacher.
*D) Any port is welcome in a storm.

pg. 23

Grammar - the examinee was asked to correct each wrong sentence by changing a single word.

The data is available in books. are
(Supplement to Thurstone, 1938, no page number).

Inventive Synonyms - (see Inventive Opposites)

tiny s small l little

A spelling test and two vocabulary tests loaded moderately on the Verbal factor (.386, .395 and .385 respectively). Thurstone describes the tests strongly associated with the Verbal factor as being logical in character; the examinees are dealing with the understanding and meaning of ideas rather than of isolated words.

In Thurstone's study of primary mental abilities a second factor emerged which was also verbal in nature. Factor W (Word Fluency) is characterized by tests dealing with single and isolated words, e.g., Anagrams (loading = .534), Disarranged Words (.512), Spelling (.508), and Grammar (.530).

Examples of items or descriptions of these tests follow:

Anagrams - make as many words as you can out of a given word, e.g., G-E-N-E-R-A-T-I-O-N-S

pg. 30

Disarranged Words - rearrange the letters on each of the following lines to spell the name of an animal.

ebar bear
odg dog
atc cat pg. 28

Spelling - an objective true-false test.

Grammar - correct each wrong sentence by changing a single word.

In none of the above tests is anything asked about the meaning of words. Fluency in dealing with words is, however, a part of the tasks involved. Thurstone's battery included a great variety of verbal tests. This undoubtedly facilitated the emergence of the two Verbal factors. Since it is the comprehension and use of the English language with which we are primarily concerned in selection tests, further discussion in this report will deal with the Verbal Comprehension (V) factor.

A second major study on the Primary Mental Abilities was carried out by Thurstone and Thurstone in 1941. The Verbal Comprehension factor was clearly defined by Vocabulary (synonyms), Reading Comprehension (paragraphs - two tests) and Proverbs with factor loadings of .68, .53, .45 and .40 respectively.

Carroll (1941) factor-analyzed verbal tests in an attempt to describe verbal behavior in terms of psychological processes rather than in terms of the type of material, (i.e., kinds of tests) associated with it. Conclusions from the study were that the Verbal Comprehension factor "appeared" to break up into several factors. One was similar to Thurstone's V, on which Vocabulary loaded .55, and which seemed to reflect experience with and knowledge of the English language. A second factor was associated with some form of reasoning ability (Verbal Analogies had a loading of .54 on it) and a third, involving similarities, inventive opposites, picture descriptions and distorted English, was not interpreted. It would seem that Carroll has succeeded in further clarifying Thurstone's V as Verbal Comprehension (no manipulation) and in establishing the fact that many verbal tests are not factor pure but have variance belonging to other separate and distinct factors, e.g., Reasoning. Unfortunately, Carroll's test battery did not contain any tests of Reading Comprehension. Davis (1944) factor-analyzed nine reading tests and isolated nine components of reading skill. The first factor, and by far the most important in terms of the variance accounted for, was interpreted as Word Knowledge. The test having the highest loading on this factor (.80) was Vocabulary, followed by tests involving inferences to be drawn from a paragraph and questions answered by the paragraph but phrased in different words (loadings are about .30 for each test). A second much less prominent factor was defined as Reasoning in Reading or the ability to see relationships among ideas. This seems to parallel Carroll's reasoning component. The remaining seven factors extracted by Davis were fairly specific to individual tests.

A reanalysis of Davis' correlation matrix by Thurstone (1946), using a different factor-analytic method, isolated but one factor on which all nine tests had factor loadings between .41 and .90. Vocabulary, drawing inferences from a paragraph and deriving the principal thought or idea from a paragraph achieved the highest loadings.

Several subsequent factor-analytic studies, (Botzum, 1951; Carroll, 1943;

Fruchter, 1948; Michael, Zimmerman and Guilford, 1951; and Taylor, 1947) using many of Thurstone's primary mental abilities tests as reference tests, continued to identify the Verbal Comprehension factor. Vocabulary tests achieved loadings ranging from .44 to .89; Reading Comprehension, .41 to .71; Verbal Analogies,.38; and Grammar, .33. Thurstone's original factors were rotated further by Zimmerman (1953) in an attempt to get rid of their large amount of residual variance and to see if these revised factors might not parallel more closely those extracted in research undertaken by the Army Air Force during World War II. The revised rotation produced a Verbal factor in which Vocabulary was much more prominent than in the original analysis (loadings increased from .40 and .38 to .76 and .68). The factor loadings for Reading I (Proverbs) and Reading II (Quotations) also increased - from .55 to .64 and from .51 to .71. A complete re-analysis of Thurstone's Primary Mental Abilities correlation matrix was performed by Wrigley, Saunders and Newhaus (1958) using a different method of factor analysis. The obtained factor loadings were, again, considerably higher than those reported by Thurstone: Vocabulary (2 tests) = .74 and .93, Reading I (Proverbs)=.79, Reading II (Quotations)=.86, Analogies=.73.

Army Air Force Research

During World War II a major project for the assessment of cognitive ability was undertaken by the Army Air Force. The Aviation Psychology Program developed and factor-analyzed hundreds of tests of many abilities for the development of the Army Air Force Qualifying Examination Classification Batteries, used to predict success in numerous Air Force jobs (pilot, bombardier, navigator, etc.). Tests of Vocabulary and Reading Comprehension were the only types of measures of Verbal ability studied in this research program (Guilford and Lacey, 1947). General vocabulary tests were found predictive of good general intelligence, the ability to comprehend written directions, and the ability to understand and remember material covered in air crew ground schools. The difficulty level of these tests was two years of college. A typical item follows:

> Choose the word that is closest in meaning to the key word.
>
> DENOTE
>
> a) regard d) refuse
> b) write e) declare
> c) indicate
>
> (Guilford and Lacey, 1947, p. 54).

Vocabulary was found to be the best measure of the Verbal factor (loadings were around .71) but was found to have limited predictive value for many specific Air Force jobs. It was, therefore, dropped from the Classification Battery.

Reading Comprehension, however, was found to have a high correlation with success especially in pilot and navigator training. Test items consisted of paragraphs which were "simple descriptions of air force jobs, the training involved and the individual characteristics required for success" (Guilford and Lacey, 1945, p. 57). Several questions were asked about each paragraph based either on specific information contained in it or on inferences which could be drawn from the material presented. The items were multiple choice with five alternatives. Numerous revisions of the Reading Comprehension test were made in an effort to present material which would be of interest to pilots, navigators and bombardiers, which would be of the required difficulty and yet of sufficient clarity, and which would present enough information to justify three or four questions based on the contents of a single paragraph. "Paragraphs were taken from a wide range of technical material... This selection was made on the basis not only of the greater pertinence to the type of reading cadets would encounter in ground school courses, but also of greater face validity" (Guilford and Lacey, 1945, p. 63). The following is an example of a Reading Comprehension item from the test designed to differentiate successful and unsuccessful navigators. It is, of course, more difficult than an item designed to rank the entire aviation student population.

> Force and counterforce are equal and opposite. A force is always accompanied by a counterforce. The force on any one body is always exerted by some other body; this other body itself experiences an equal and opposite force. The two are parts, or different aspects, of one inseparable whole.
>
> 1. The general principle most justifiably derived from this paragraph is that:
>
> A) The resultant of two forces cannot equal one opposing force.
> B) All forces in the universe maintain equilibrium.

C) Force and counterforce differ in magnitude rather than direction and can thus be considered as parts of one inseparable whole.
D) The effect of a number of forces and counterforces acting on an object is always movement.
E) The work done by a body is not a function of the strength of the forces and counterforces.

2. In the case of pressing one's hand against a wall, the statements in the paragraph:

A) Would be true depending upon the amount of force with which one pushed.
B) Would be true only if the wall were rigid.
C) Would be true only if the wall moved in the direction of the force.
D) Would be true only if something were pushing against the wall from the other side.
E) Apply without qualification.

3. The statements in the paragraph imply that a strong man striking a much weaker man would encounter a force:

A) Equal to his own.
B) Less than his own.
C) Greater than his own.
D) That would vary with the difference in strength between the strong and the weak man.
E) That would cause equal movement in the bodies of the weaker and the stronger man (from Guilford and Lacey, 1947, p. 63).

The reading comprehension test from which these items were taken loaded .54, .58 and .52 on the Verbal factor in factor-analytic studies of the December 1942, November 1943 and September 1944 Air Force Classification Batteries (Guilford and Lacey, 1947). A Reading Comprehension test was also used as a reference test for the Verbal factor in Air Force factor-analytic studies of Reasoning tests, Foresight and Planning tests, Integration tests and Memory tests. Verbal factor loadings for Reading Comprehension were .65, .69, .60 and .67 in these four studies respectively. As might be expected, loadings of .27 to .48 on a General Reasoning factor were reported in some of these studies. All of the foregoing research is concisely summarized by French (1951).

Further Factor-Analytic Research

After World War II, studies involving many tests developed or suggested by the Air Force and Thurstone's work continued. Reading Comprehension tests continued to appear as part of the Verbal factor and in most studies general vocabulary tests reappeared as excellent reference tests for verbal ability. The results of representative studies in which a Verbal factor was found are summarized in Table I. The examinees in the majority of these studies were Army and Air Force personnel (e.g., air cadets, student officers, pilot trainees, army enlisted men); the remaining studies employed either high school or college students.

It should be emphasized that factor loadings from the various studies are not directly comparable. The factor composition of any battery of tests is a function of the intercorrelations among the tests and these intercorrelations are, of course, influenced by the number and kinds of measures in the battery, the number of examinees tested and the range of the ability level among these examinees. The studies cited in Table I serve to illustrate the consistent emergence of the Verbal Comprehension factor regardless of the examinee population or the overall composition of the test battery. The Verbal factor appears whenever tests of Vocabulary and/or Reading Comprehension paragraphs are incorporated into the test battery, as well as when other tests in the verbal medium, (e.g., analogies) are present.

The increasingly frequent use of Vocabulary as a reference test for the Verbal factor is demonstrated in Table I. French, Ekstrom and Price (1963) and Ekstrom, French and Harman (1976) suggest that multiple choice Vocabulary tests based on synonyms are the best for picking up individual differences in Verbal Comprehension. These tests can sample many features of a language, they are relatively easy to construct and administer, their loadings on the Verbal factor are higher than the loadings of other item types and they are less likely to load on other factors.

TABLE 1

Summary of Representative Factor-Analytic Studies (1948-1974) in which the Verbal Comprehension Factor was Identified, with Verbal Factor Loadings for Item Types Used in Each Study

Authors	Year	Group	TEST ITEM TYPE Reading Comp.	Vocab-ulary	Verbal Analogies	Reading & Vocabulary
Dudek	1948	1	.62			
		2	.61			
		3	.58			
Michael	1949	1	.62			
		2	.53			
		3	.60			
Adkins & Lyerly	1952		.51, .39	.41		
Fruchter	1952		.56	.71		.62
Roff	1952		.30	.53		
Zachert & Friedman	1953	1	.59			
		2	.49			
		3	.56			
		4	.52			
Green, Guilford, Christensen & Comrey	1953			.53	.48, .42	
Hertzka, Guilford, Christensen & Berger	1954		.56	.50		
Wilson, Guilford, Christensen & Lewis	1954			.65		
Guilford, Green, Christensen, Hertza & Kettner	1954		.34	.69	.33	
Kettner, Guilford & Christensen	1956		.51			.70
Berger, Guilford & Christensen	1957			.71, .73		
French	1957		.43	.66		
Frick, Guilford, Christensen & Merrifield	1959			.57		
Kettner, Guilford & Christensen	1959			.64, .79		

TABLE 1 (cont.)

Authors	Year	Group	Reading Comp.	Vocab-ulary	Verbal Analogies	Reading & Vocabulary
*Guilford, Merrifield Christensen & Frick	1961			.51		
*Merrifield, Guilford, Christensen & Frick	1962			.52		
Kelley	1964		.48	.60		
*Hoepfner, Nihira & Guilford	1966					.70
Lemke, Klausmeier & Harris	1967			.74,.90		
Very	1967		.76	.89		
Dunham & Bunderson	1969			.76, .89		
Hakstian & Cattell	1974		.70	.43	.71	

*Verbal comprehension factor became Cognition of Semantic Units (Vocabulary and Reading Comprehension tests); Cognition of Semantic Relations or Cognition of Semantic Systems (Reading Comprehension Tests) in Guilford's Structure-of-intellect Model.

Guilford and Hoepfner (1971) cite 17 studies in which vocabulary tests were associated with the factor Cognition of Semantic Units, with factor loadings ranging from .50 to .78. Seven studies were cited in which Reading Comprehension had loadings of .48 to .76 on the same factor. Factor loadings on Cognition of Semantic Relations and Systems were around .40.

The following are examples of vocabulary test items from measures varying in level of difficulty:

Choose the word that has the same meaning or nearly the same meaning as the key word.

jovial	
1) refreshing	Ekstrom, French
2) scare	and Harman, 1976,
3) thickset	p. 166. Vocabu-
4) wise	lary II for
5) jolly	grades 7-12
nascent	Suggested by an
1) nasty	item from the Ad-
2) bright	vanced Vocabulary
3) beginning	Test for grades
4) buoyant	11-16. Ekstrom,
5) wide	French and Har-
	man, 1976, Kit of
	Factor Referenced
	Cognitive Tests.

Frequently Vocabulary items are written so that the key word is to be defined in a sentence context, e.g.,

He had LURED his victim with false promises.

a) enticed	Very, 1967, p. 195
b) traversed	(from English Place-
c) palliated	ment Test, Penn. State
d) ensconced	Univ.)
e) NONE	

Reading Comprehension items based on a paragraph and a multiple choice question concerning its interpretation, "main idea," or an inference which can be drawn from the paragraph represent a more diverse aspect of verbal ability. Factor loadings on the Verbal factor for these tests are frequently lower than those for Vocabulary because their variance is shared by other factors--most notably some form of Reasoning (General, Inductive or Deductive). The reasoning component in paragraph reading is to be expected when the task involves abstracting a theme or making an inference from the material presented.

The subject matter for reading comprehension items in any particular test now usually comes from a great variety of sources (the arts, technology, economics, scientific areas, etc.). Since the task of the examinee is to respond to a question or questions about the given paragraph, knowledge of, or experience with, the subject of the paragraph is not necessary.

Of the numerous other item-types developed and used by Thurstone, Guilford and others exploring the Verbal dimension of cognitive ability, one that is still widely used, although not usually as a reference test for the Verbal factor, is the Verbal Analogy. Guilford and Hoepfner (1971) cite eight studies, done in Guilford's own laboratory, in which Verbal Analogies were found most strongly associated with the structure of intellect factor Cognition of Semantic Relations. Factor loadings varied from .32 to .67 in these reports. Three other investigations in which Verbal Analogies contributed to the identification of the Verbal Comprehension factor are listed in Table I. An analogy problem, however, involves discovering the rule or principle which governs the relationship (inductive reasoning) and therefore the solution requires reasoning ability as much as it requires Verbal Comprehension.

In conclusion, it is evident that Verbal Comprehension, the ability to understand the English language, is a well-documented mental ability, consistently identified by a variety of verbal measures, especially those concerned with vocabulary or reading. Vocabulary items are the purest measures of the factor (i.e., they share little variance with other ability factors) but Reading Comprehension items (e.g., paragraphs, proverbs) although contributing to other factors such as those associated with reasoning, sample other and therefore broader aspects of the ability.

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